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Procedia Economics and Finance 22 (2015) 353 – 362

Procedia Economics and Finance

www.elsevier.com/locate/procedia

2nd International Conference 'Economic Scientific Research - Theoretical, Empirical and Practical Approaches', ESPERA 2014, 13-14 November 2014, Bucharest, Romania

Corporate Entrepreneurship and Innovation in the Renewable Energy Field

Adrian Tantau[a]*, Alexandra Chinie[a], Filip Carlea[b]

[a]*Bucharest University of Economic Studies, Piata Romana nr. 6, Bucharest, 010374, Romania*
[b]*National Institute for Economic Research "Costin C. Kiriţescu", Calea 13 Septembrie, no. 13, Sector 5, Bucharest, Romania*

Abstract

In the context of depleting natural resources, climatic changes and consequently worldwide interest to generate energy from renewable sources, energy and non-energy companies have diversified their portfolio by investing in renewable energy. This has developed a growing interest in finding out what supports the corporate entrepreneurial behavior in the renewable energy field. With the improvement of renewable energy technologies and changes of the financial support systems, the further development of the renewable energy business strongly relies on innovation, in terms of technology and business models. The present article aims at assessing the innovation characteristics of companies that have broadened their domain of activity by investing in renewable energy, as well as to identify which organizational support factors would influence these characteristics the most. The analysis is based on a study of 30 companies that have invested in renewable energy following a corporate entrepreneurship strategy. Results suggest that management support for corporate entrepreneurship and work autonomy are the organizational factors that would support innovation in these diversifying companies the most.

Selection and/or peer-review under responsibility of the Scientific Committee of ESPERA 2014

Keywords: corporate entrepreneurship; innovation; renewable energy

* Corresponding author. Tel: +40721325444
E-mail address: ad_tantau@yahoo.com

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doi:10.1016/S2212-5671(15)00302-0

1. Introduction

The renewable energy business landscape has been lately characterized by technological improvements and reduction of investment costs, but also uncertainty regarding financial support and a yet slow diffusion of renewable energy technology.

Starting with 2012, many governmental support programs have been diminished or cancelled. Romania has ceased the payment of green certificates until 2017, while countries such as Spain, the Czech Republic, Greece and Bulgaria have announced retroactive cuts (Frankfurt School, 2014). Germany plans on reducing the average subsidy for wind, solar and other renewable power sources to an average of €0.12 per kilowatt-hour in 2015, dropping from €0.17 in 2014 (Thomas, 2014). In an article published by EIA (2014), the organization states that policy uncertainty may slow down the renewable energy expansion in the next five years.

With the shift towards a more sustainable energy generation and the development of the renewable energy business, utilities are currently threatened by the changes of the market (Klose et.al., 2010; Schoettl and Lehmann-Ortega, 2011). They will need to rethink their business models in order to be profitable on the long run. In order to adapt to the paradigm shift and the technology-push created by renewable energy technologies, utilities have also integrated renewable energy generation into their business model (Masini and Menichetti, 2013; Richter, 2013); As Pinkse and van Buuse (2012) have stated, integrating a new technology into the company's business depends on the company's abilities and how easily it may be integrated in their supply chain.

In a research performed by Negro et. al (2012), the slow diffusion process of renewable energy is explained by two paradigms: support mechanisms aiming to compensate for private under investments have been weak in identifying where these should be targeted to and to what level; the second paradigm is based on creating, through policies, a favorable environment for the development of innovations. Scholars have studied new growth opportunities for the renewable energy field, and have underlined the importance of entrepreneurship in the process (Pinkse and van den Buuse, 2012; Wüstenhagen and Menichetti, 2012; Bergek et. al., 2013). Hockerts and Wustenhagen (2010) state that an ambidextrous innovation policy for sustainability is needed in order to support both large and small companies that wish to invest in renewable energy.

In this context, the abilities of the company to innovate their business plan in order to integrate renewable energy have gained importance. In order to understand how innovation is fostered in energy companies and diversifying companies that have invested in renewable energy, the authors have tried to answer the following research questions: What defines the organizational entrepreneurial system of companies that have invested in renewable energy? Which variables influence innovation in these companies?

The present analysis is part of a broader study that aims at assessing how the organizational support system influences the entrepreneurial characteristics of companies that have invested in renewable energy following a corporate entrepreneurship strategy. The correlation between organizational support and innovation in the targeted enterprises are assessed through non-parametric tests such as the Kruskall-Wallis test and the Spearman correlation factor. The main scope of the research is to highlight the internal organizational support factors that may have the highest impact on innovation in entrepreneurial companies investing in renewable energy.

2. Conceptual framework

2.1. Corporate Entrepreneurship in the renewable energy field

Corporate Entrepreneurship in the renewable energy field may be classified as being part of a broader type of entrepreneurship: sustainable entrepreneurship or eco-entrepreneurship. According to Miles et. al. (2008), sustainability forces corporations to reconsider their strategies and tactics in light of the impact on long-term economic performance, sound environmental management, and social accountability norms. Fussler and James (1996) consider that sustainability drives the creation of new markets through environmental innovation. The authors also see it as a "breakthrough discipline for innovation". Sustainability and innovation have often been linked in the literature (Hockerts and Wustenhagen, 2010; Schaltegger and Wagner, 2011).

According to Schaltegger and Wagner (2011), one can distinguish between the private benefit of an innovation and the social benefit, which is defined for sustainability innovation: "the higher the private benefit, the higher is the potential of an innovation to compensate for negative social effects of that innovation". The current renewable energy field presents opportunity both for technology and business innovation. The diffusion of renewable energy technologies strongly relies on access to technology licenses (Ockwell et. al., 2010), but it is also strongly influenced by other entrepreneurial systems and tools, as further presented. According to Foxon et. al. (2008), the process of diffusion of a specific technology is reflected in the formation and evolution of technological innovation systems, processes for which both policy makers and entrepreneurs play an important part.

Business innovation in the renewable energy field has been characterized by new ways of investing, transferring knowledge and diffusing technological innovations. Buitenhuis and Pearce (2012) identified four such business models: the partnership model, the franchise model, the secondary supplier model and the completely open-source design. The partnership model presented by the authors is based on sharing intellectual property. The franchise model is used to create geographical boundaries while collaborating with other firms and improving R&D: "the supplier would not grant more than one manufacturer for one territory, and the manufacturer would agree to not do business outside their own territory". In the secondary supplier model, "encouraging the opening of design within the primary industry would be in the best interest of the secondary industry" (Buitenhuis and Pearce, 2012). The completely open-source design model is based on an open publication of all research. Understanding how innovation is supported in companies that invest in renewable energy would lead to a better comprehension regarding how sustainable technological improvements and business model innovation are achieved in the renewable energy field.

2.2. Correlation between organizational support and innovation for corporate entrepreneurship in the renewable energy field

Research has demonstrated that management support for innovation, as well as the organizational structure, control systems and firm incentives contribute to creating organizational antecedents that stimulate future corporate entrepreneurial initiatives from company members (Kuratko et.al., 2005).

A corporate entrepreneurial initiative can occur due to internal motivational factors of an employee, such as an employee's inspired idea, that is pursued in order to gain personal satisfaction and organizational recognition (Schindehutte et.al., 2000), but research findings indicate that a positive perceived *organizational support* by the employees represents a critical element to determining a favorable working environment, that stimulates creative business contributions and thus a motivating employee behavior towards the company's objectives (Eisenberger et. al., 2002). A *motivating working environment* that values employee achievements and innovating ideas is an essential element in revealing the entrepreneurial abilities of the company members.

Eisenberger (2001) states that based on the reciprocity principle, a positive perceived organizational support of the company towards the employees and their professional recognition within the organization induce a higher job commitment and motivation for employee initiatives on their behalf. This is why a flat organization that encourages the management-employee communication and thus stimulates the exchange of business ideas is more likely to produce corporate entrepreneurs than a hierarchical organization, that tends to intimidate the communication pathways due to the numerous management levels and a stiff organizational culture that encourages the horizontal communication mostly.

The management plays a critical role for employee contributions to corporate entrepreneurship (Scheepers et. al., 2008) by encouraging the employee initiatives and offering the necessary resources for the feasible business ideas,

avoiding sanctions in case of initiative failure and delegating employees to find innovative solutions to certain business challenges within the company. According to the findings of Shamsuddin et. al. (2012), there are certain proportional connections between the external organizational factors and the three dimensions of corporate entrepreneurship, as follows: the company resources, supportive organizational structure and rewards system influence the relationships between proactiveness and financial performance, and between risk-taking and financial performance; Kuratko et. al. (2005) defined management support as "the willingness of top level managers to facilitate and promote entrepreneurial behavior, including the championing of innovative ideas and providing the resources people require to take entrepreneurial actions".

The rewards system and the resource availability are cultural elements that determine employees to have entrepreneurial initiatives (Goodale et. al, 2011). The organizational cultures that tend to stimulate the creativity of their staff, as well as risk taking, by granting them financial and social rewards have better chances of having internal entrepreneurs than the ones that are risk-adverse. Rewards have always been a primary source of motivation for someone to act in order to achieve their goals and within companies they remain a persuasive source of motivating employees to dedicate more of their time and energy to achieving the organizational goals.

The Corporate Entrepreneurship Assessment Instrument developed by Hornsby et. al. (2002) mentions organizational boundaries, time availability and work discretion as other important factors for stimulating corporate entrepreneurship, along with management support and rewards. Employees must have the necessary time to fulfill their job tasks and to seek business opportunities individually or as a team and the right to take certain decisions and acts without permanently asking for supervisors' and managers consent. Bureaucratic formalities and stiff hierarchical subordination are two obstacles for innovation inside the organization and represent a challenge for the management, which is obliged to maintain a certain degree of control and offer the necessary space for employees to bring their own ideas. The freedom of employees to manage their activity, take risks and innovate, supported by Hornsby et. al. (2002) under the concept of "work discretion", assures the generation and dissemination of new ideas and a better management of change when undertaking a new entrepreneurial activity by the company. The present paper further assesses the five organizational elements proposed by Hornsby et. al. (2002) in the 30 companies included in the study.

3. The research method

The analysis is based on data gathered from 30 companies that have diversified their domain of activity by investing in the renewable energy field. The data collection phase took place between January 2013 and February 2014, and consisted of creating a database with companies that have invested in renewable energy following a corporate entrepreneurship initiative and sending out structured interviews to managers involved in the renewable energy business of the company. The selected companies were searched online, and included both energy companies and companies with no background in the energy field. We collected contact information for 36 companies which produce renewable energy in Romania but had had a different main field of activity. We sent out a structured survey per email. We made telephonic follow-ups for companies that haven't answered our email. In total we gathered 12 responses. We identified further companies that have invested in renewable energy from online databases and sent another 240 valid emails, to which we received 14 responses. During an energy fair, we personally interviewed another 4 companies. The companies that participated to the study are active in Europe, the Middle East and Africa.

The first set of questions included in the survey referred to the primary domain of activity of the respective company, the size of the company, and the renewable energy field in which they are active. Questions regarding the main field of activity and the renewable energy field were multiple choice. Respondents were asked to select among the main types of renewable energy: solar energy, hydropower, wind power, biomass, bio fuel, geothermal (renewablesguide.co.uk, 2014), and enabling technologies. The reason for these main categories to be included in the questionnaire was their importance in achieving the European Union's 2020 target plan for renewable energy (Beurskens and Hekkenberg, 2011). However, respondents were able to fill in a different kind of renewable energy, if their product didn't fit any of the predefined categories. Different types of renewable energy filled in by respondents were landfill gas, energy from heat recovery and from other waste materials.

Hornsby's et. al (2002) organizational support factors were measured based on five sets of questions referring to each dimension. The sets of questions used in the present analysis include items that have had results of the substantive validity test higher than 0.7 for management support and rewards/reinforcement, higher than 0.77 for organizational boundaries, higher than 0.9 for work discretion and higher than 0.95 for time availability, in the authors' study (Hornsby et. al., 2002). The five dimensions were measured on a seven points Likert scale.

Innovation was analyzed through a set of six questions, referring to "the company's emphasis on R&D, innovation and technological leadership" (INN1); "the number of lines of products and services" (INN2); "changes in product or service lines" (INN3); "reorganizing units/divisions to increase innovation" (INN4); "activities undertook to increase innovation" (INN5); and "organizational structures to increase innovation" (INN6). Items are based on Miller and Friesen (1982), Covin and Slevin (1991).

4. Results and analysis

The most predominant primary domains of activity of the surveyed companies were energy (15 companies) and technology (5 companies). Consultancy services and retail were each selected by 2 companies, while consumer goods and services were selected by 3 respondents. Other domains filled out by respondents were waste management, industrial goods and transportations.

Among the interviewed companies, most investments in renewable energy were done in solar energy (13 respondents). Wind power, hydropower and bio mass are all represented by 8 of the respondents each. Although the share of solar power is still lower in Europe than wind power, hydropower and biomass according to "The state of renewable energies in Europe" report (EurObserv'ER, 2013), concentrating solar thermal power has acknowledged a global annual growth rate of 61% in 2012 (REN21, 2013) and 39% in 2013 (REN21, 2014). The renewable energy fields in which the interviewed companies have least invested are enabling technologies (4 companies) and geothermal energy (3 companies).

The largest share of companies that invested in renewable energy following a corporate entrepreneurship strategy are small: 19 of the respondents are companies with 1 to 50 employees (small companies), 7 are companies with 50 to 500 employees (medium and large), while 4 companies have more than 500 employees (enterprises).

The internal organizational factor that was rated the highest among the renewable energy corporate entrepreneurs was work discretion, while the lowest rating was given for time availability. Although the average ratings were higher than those from a study performed by Kuratko et. al. (2005), the two charts are similar. In the author's study, the highest ranked organizational factor was also work discretion, while the lowest rated was time availability (Figure 1).

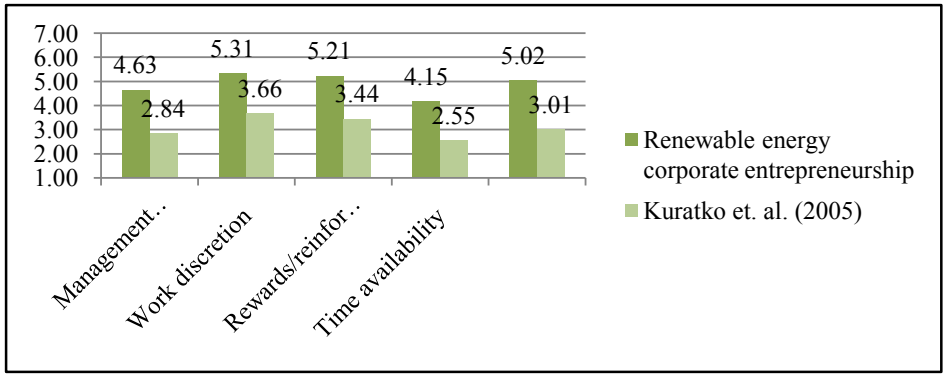

Fig 1. Comparison between ratings for organizational factors of renewable energy corporate entrepreneurs and the ratings of Kuratko's study (2005)

The lowest rated innovation items were “many new lines of products or services”(INN2), with a median rating of 3 and an average rating of 3.79, and “dramatic changes in product or service lines”(INN3), with a median rating of 4 and an average rating of 3.46. These items were rated with low scores between 1 and 3 by 15, respectively 14 of the respondents. The low rating of INN3 may suggest a tendency to avoid radical innovation in the companies that participated to the study (Figure 2).

“Adopting flexible organizational structures to increase innovation”, with a median rating of 5 (same as INN1, INN4 and INN5) and the highest average rating (5.13), was rated with scores between 5 and 7 by 22 out of the 30 respondents. The second highest rated innovation item, “coordinating activities to enhance innovation”, with an average rating of 4.96, has been rated with scores between 5 and 7 by 21 respondents.

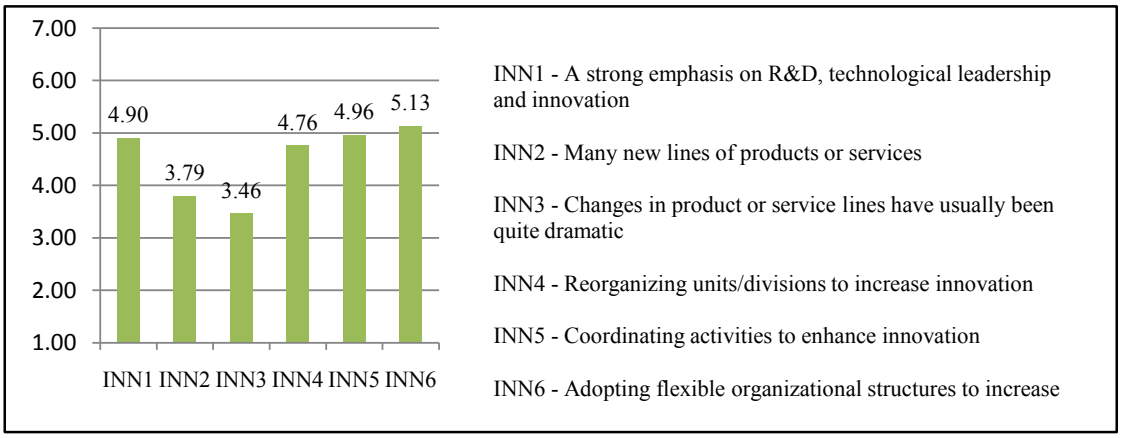

Fig 2. Average ratings of the innovation characteristics on a 7-point Likert scale

Looking at the characteristics of the surveyed companies and their ratings for innovation, no significant difference of the average scores for the innovation items is observed between different company sizes. Although most ratings are a bit higher for diversifying companies with no energy background, as opposed to energy companies that have invested in renewable energy, only “many new lines of products or services”(INN2) has had an average rating higher with over 1 point for diversifying companies than the average rating of utilities.

The paper further presents which organizational support factors would influence innovation characteristics most in the studied companies. The analysis is based on the Kruskal-Wallis test in the SPSS software, which is a generalization of the Wilcoxon Mann-Whitney U test. It is used to compare differences between two independent groups when the dependent variable is either ordinal or continuous, but not normally distributed. In the study of renewable energy corporate entrepreneurship support factors, the correlations between the internal support dimensions of the enterprise and the innovative orientation of the company were measured. The main objective of the study was to identify the items that have the most influence on innovation in the renewable energy field. The assumptions of the Kruskal-Wallis were verified according to Varga and Delaney (1998).

The non-parametric version of the Levene test (Nordstokke and Zumbo, 2010) was used in order to analyze the homogeneity of variance of the studied groups, which is one of the assumptions which the Kruskal-Wallis test relies on. The result of the test is given by performing an ANOVA test on the absolute difference between the rank of each independent variable and the mean rank of the group. If the ANOVA test is statistically insignificant (p value higher than 0.05), then there is no difference between the group variances, which proves the homogeneity of variance.

The Levene test was performed for each pair of groups that resulted as correlated following the Kruskall-Wallis test. Out of 17 correlations, six were removed for failing the Levene test (Table 1).

Innovation item number one, “a strong emphasis on R&D, technological leadership and innovation “, is the innovation item mostly influenced by organizational support factors. The organizational support factor with most significant results of the Kruskal-Wallis test is management support. In order to assess the level of correlation between the identified related items, the authors performed a Spearman correlation analysis. The results in Table 2

were retrieved. Spearman correlation factors marked with borders reflect relationships for which the Kruskal-Wallis test was significant.

Table1. Dependencies between organizational factors and innovation based on a Kruskal-Wallis analysis; representation of the p significance values

Support factor †	Description	INN1	INN2	INN3	INN4	INN5	INN6
MS1	My organization is quick to use improved work methods	0.030*	0.541	0.123	0.794	0.294	0.035*
MS2	My organization is quick to use improved work methods that are developed by workers.	0.002**	0.275	0.780	0.518	0.006**	0.004**
MS3	Those employees who come up with innovative ideas on their own often receive management encouragement for their activities.	0.064	0.657	0.621	0.486	0.029^{+}	0.098
MS4	Many top managers have been known for their experience with the innovation process.	0.005**	0.477	0.792	0.540	0.469	0.104
MS5	There are several options within the organization for individuals to get financial support for their innovative projects and ideas.	0.357	0.665	0.918	0.946	0.613	0.750
MS6	Individual risk takers are often recognized for their willingness to champion new projects, whether eventually successful or not.	0.078	0.977	0.477	0.553	0.683	0.768
MS7	People are often encouraged to take calculated risks with new ideas	0.007**	0.391	0.795	0.171	0.490	0.303
MS8	The term ‘‘risk taker’’ is considered a positive attribute for people in my work area.	0.065	0.233	0.958	0.823	0.759	0.607
MS9	This organization supports many small and experimental projects realizing that some will undoubtedly fail.	0.220	0.185	0.778	0.877	0.403	0.139
WD1	I feel that I am my own boss and do not have to double check all of my decisions.	0.306	0.366	0.042^{+}	0.219	0.440	0.277
WD2	This organization provides freedom to use my own judgment	0.100	0.536	0.013^{+}	0.550	0.025^{+}	0.026^{+}
WD3	I have the freedom to decide what I do on my job.	0.012*	0.244	0.775	0.592	0.025^{+}	0.005**
WD4	It is basically my own responsibility to decide how my job gets done.	0.160	0.959	0.166	0.575	0.140	0.547
WD5	I almost always get to decide what I do on my job.	0.199	0.666	0.445	0.818	0.381	0.120
WD6	I have much autonomy on my job and am left on my own to do my own work.	0.244	0.316	0.158	0.347	0.219	0.124
TA1	I always seem to have plenty of time to get everything done.	0.431	0.385	0.923	0.441	0.056	0.432
TA2	I feel that I am always working with time constraints on my job.	0.915	0.293	0.392	0.949	0.045*	0.511
TA3	I have just the right amount of time and work load to do everything well.	0.434	0.779	0.416	0.351	0.556	0.258
RR1	My supervisor will increase my job responsibilities if I am performing well in my job.	0.207	0.523	0.369	0.291	0.707	0.421

RR2	My supervisor will give me special recognition if my work performance is especially good.	0.419	0.204	0.796	0.005**	0.618	0.569
RR3	My manager would tell his boss if my work was outstanding.	0.304	0.186	0.376	0.806	0.264	0.291
OB1	On my job I have no doubt of what is expected of me.	0.585	0.775	0.983	0.608	0.805	0.552
OB2	In the past three months, I have always followed standard operating procedures or practices to do my major tasks.	0.932	0.890	0.348	0.103	0.405	0.733
OB3	I clearly know what level of work performance is expected from me in terms of amount, quality, and timeliness of output.	0.545	0.993	0.946	0.890	0.325	0.709

ƒ Authors abbreviation for the six organizational elements: management support, work discretion, rewards/reinforcement, organizational boundaries
*significance at 0.05 level
**significance at 0.01 level
+ failed the Levene test

The strongest significant correlation, with a factor of 0.608, was identified between MS2, "My organization is quick to use improved work methods that are developed by workers", and INN1, "the company's emphasis on R&D, innovation and technological leadership", while also being positively related to INN6, "organizational structures to increase innovation", and INN5, "coordinating activities to enhance innovation". The second organizational factor that may influence innovation in renewable energy diversifying companies is autonomy. WD3, "I have the freedom to decide what I do on my job" is strongly correlated to INN6 and INN5. This result corresponds to that of Kuratko et. al. (2005), who identified "work discretion" as the organizational element that has the highest influence over entrepreneurial actions within companies. Correlation factors for "organizational boundaries" and "time availability" were too low to be considered significant. "Organizational boundaries" has not been significantly correlated to any innovation items. The innovation items with the lowest ranking among the respondent companies, INN2 and INN3, are also not significantly correlated to any of the organizational factors.

Table2. Spearman correlation factors between innovation and organizational elements

		INN1	INN2	INN3	INN4	INN5	INN6
MS1	Correlation Coefficient	0.479	0.002	-0.272	-0.125	0.282	0.445
	Sig. (1-tailed)	0.004**	0.496	0.081	0.259	0.073	0.007**
MS2	Correlation Coefficient	0.608	0.260	-0.138	0.053	0.581	0.583
	Sig. (1-tailed)	0.000*	0.086	0.242	0.393	0.001**	0.000**
MS4	Correlation Coefficient	0.563	0.133	0.113	0.108	0.190	0.414
	Sig. (1-tailed)	0.001**	0.258	0.295	0.299	0.181	0.016
MS7	Correlation Coefficient	0.499	0.261	-0.132	-0.346	0.217	0.243
	Sig. (1-tailed)	0.003**	0.086	0.251	0.033*	0.134	0.098
WD3	Correlation Coefficient	0.593	0.279	0.083	0.097	0.429	0.601
	Sig. (1-tailed)	0.001**	0.075	0.344	0.312	0.014*	0.001**
TA2	Correlation Coefficient	-0.003	0.342	0.074	0.088	0.440	0.283
	Sig. (1-tailed)	0.495	0.037*	0.358	0.332	0.012*	0.085
RR2	Correlation Coefficient	0.293	0.387	-0.022	0.468	0.231	0.256

Sig. (1-tailed)	0.073	0.025*	0.459	0.008**	0.139	0.103

*Correlation is significant at the 0.05 level (1-tailed)
** Correlation is significant at the 0.01 level (1-tailed)

"Management support" and "work discretion" are the organizational elements that may best function as leverage for the development of technological innovation in the renewable energy field.

5. Conclusions

Past researches have proven the correlation between the organizational culture and support system and corporate entrepreneurship, and have structured organizational dimensions that can shape the entrepreneurial spirit of the enterprise. One of the main corporate entrepreneurship characteristics that describe the entrepreneurial orientation of the company and recurrently appears in academic and organizational studies is the company's ability to innovate. Given the current context of the renewable energy business and the advancement of the renewable energy technologies, but also the recent changes of the business' support system, the company's ability to innovate is one of the characteristics that may define the success of a company investing in the renewable energy field.

The research presented in this paper aimed at assessing innovation and finding the main organizational factors that may influence the innovative orientation of corporate entrepreneurs from the renewable field. Work autonomy, or the freedom to manage one's activities, to make new proposals and to assume risk, may support innovation in the renewable energy field by allowing the formation of organizational structures that would foster innovation.

Supporting bottom-up innovation through the implementation of work methods improved by employees may impact corporate innovation on multiple levels, such as R&D, activities and structures to increase innovation. Also, encouraging employees to take calculated risk would foster technological innovation within the company.

The results of the study offer an insight into how innovation may be supported in diversifying companies that integrate renewable energy into their business. A better understanding of this matter may be capitalized on by individual companies, but also renewable energy clusters and networks that aim at sharing knowledge and collaborating for innovation of this field. A more efficient integration of renewable energy as new product or business may lead to further growth of the industry despite diminished governmental financial support.

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